

# **ERDA/NASA-MSFC SOLAR HEATING AND COOLING DEVELOPMENT AND DEMONSTRATION PROGRAM**

by

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The MSFC involvement in solar heating and cooling stems from experience with environmental control systems in space vehicles such as Apollo and Skylab and will continue with present programs providing environmental protection for space crewmen and equipment.

This technology development includes special thermal coatings, insulating materials, thermal fluids, both active and passive heating and cooling systems, and includes protection for man as well as equipment for the harsh environments of space at the extreme temperatures experienced.

This technology and experience seemed a natural application for a more conventional use such as the heating and cooling of buildings using solar as the primary energy source. The thermal coatings, materials, insulation, processes, and heating and cooling techniques were key ingredients to designs of solar collectors, selection of thermal transfer fluids, storage devices, and heating and cooling equipment utilizing solar energy.

As a result, MSFC became actively involved in 1973 and 1974 in designing and building a system to heat and cool a representative residential building using solar energy. This system, using some newly designed equipment and some modified conventional equipment, was to allow testing and evaluation of the system, subsystems, and components under actual operating conditions and to provide data on operating characteristics, system analysis of such systems, and to serve as an engineering tool in design improvement of such systems.

During this activity, the outlook for energy sources began to be of prime concern to the U.S., particularly the increasing dependence upon foreign oil and decreasing supplies of domestic oil and natural gas. As a result, Project Independence was initiated by the President and Congress, recognizing the need for programs at the Federal level to provide the stimulus for creating new energy sources, or in the case of solar, developing technology and equipment to utilize the source — effectively, economically.

The following figures show example illustrations of the MSFC solar heating and cooling effort that has now become part of the national program.

Figure 1 gives information on the National Solar Heating and Cooling Program in which MSFC has an important role. The Energy Research and Development Administration (ERDA) has the overall lead responsibility for the program.

# NATIONAL SOLAR HEATING & COOLING PROGRAM

AUTHORIZED BY LEGISLATION-----

SOLAR HEATING & COOLING ACT  
OF 1974

TO---

DEMONSTRATE PRACTICAL USES OF---

SOLAR HEATING SYSTEMS BY END  
OF FY77

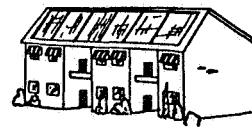
COMBINED SOLAR HEATING & COOLING  
SYSTEMS BY END OF FY79

FOR APPLICATION TO

RESIDENTIAL BUILDINGS ---



MULTI-FAMILY BUILDINGS ---



COMMERCIAL BUILDINGS ---



Figure 1. Description of the National Solar Heating and Cooling Program.

Figure 2 explains the goal of the national program. The end result of the national plan is to assist in gaining public acceptance of solar energy utilizing heating and cooling systems and to provide the stimulus for commercial production of these systems. Volume production of these systems will help drive unit costs down, making solar energy use a more attractive and cost-effective alternative to present fuel systems.

TO STIMULATE THE CREATION OF A VIABLE  
INDUSTRIAL AND COMMERCIAL CAPABILITY  
TO PRODUCE AND DISTRIBUTE SOLAR HEATING  
AND COOLING SYSTEMS. THE WIDESPREAD  
APPLICATION OF THESE SYSTEMS CAN REDUCE  
THE DEMAND ON PRESENT FUEL SUPPLIES.

Figure 2. Overall goal of the National Solar Heating and Cooling Program.

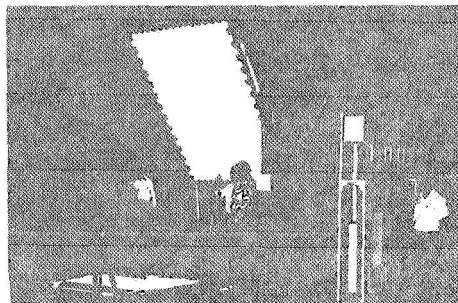
MSFC has an assigned role in the national plan. Figure 3 lists MSFC major responsibilities in support of the ERDA program. MSFC's role is to develop solar energy equipment utilizing industrial support and on-site MSFC test facilities to support the national program. After these systems and sub-systems are developed and checked out, a part of them will be tested at MSFC under simulated field conditions. Also these and other systems will be installed in a wide range of climatological and geographical locations for operation, observation, and evaluation of performance.

- DEVELOPMENT IN SUPPORT OF DEMONSTRATION
  - MANAGE THE DEVELOPMENT AND TESTING OF SOLAR HEATING & COOLING SYSTEMS AND SUBSYSTEMS LEADING TO MARKETABLE PRODUCTS
  - DEVELOP AND PROVIDE DATA ACQUISITION EQUIPMENT TO SUPPORT NATIONAL DATA PROGRAM
  - COLLECT, PROCESS AND EVALUATE TECHNICAL DATA FROM SELECTED SITES
- COMMERCIAL DEMONSTRATION
  - SUPPORT THE COMMERCIAL DEMONSTRATION SITE SELECTION PROCESS
  - MANAGE SELECTED SITES

Figure 3. MSFC's major responsibilities in support of ERDA programs.

The Commercial Demonstration Program's objective is to provide an early interface with the public and industry to solar heating and cooling equipment. Proposals are evaluated from builders, equipment manufacturers, and industries to install solar systems in which the government will cost-share the solar system procurement and installation. Performance data will be gathered and the system operation evaluated.

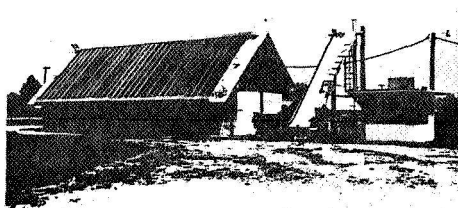
MSFC has several test facilities to support the national program (Fig. 4). The solar simulator is a large tungsten-halogen lamp array housed in one of the onsite buildings which provides a controllable and variable solar insulation simulation for testing solar collectors. The solar house, previously mentioned, provides an engineering unit with 1300 ft<sup>2</sup> of roof mounted collectors and simulates a 2500 ft<sup>2</sup> residence. It consists of three interconnected house trailers under a free-standing roof. The Solar Heating and Cooling Systems Test Facility is a 20-acre site at MSFC providing out-of-door testing of components, subsystems, and systems with measurement data collected and recorded by the facility's data collection system. Systems checked out from the development program will be installed in operational test sites selected throughout the U.S.



SOLAR SIMULATOR



BREADBOARD TEST FACILITY



MSFC SOLAR HOUSE TEST FACILITY



OPERATIONAL TEST SITE

Figure 4. Solar heating and cooling test facilities.

Figure 5 is a photo of an off-site project of the Development and Commercial Demonstration Program — Cambridge Development Group's townhouse development in Columbia, South Carolina. This unit will be installed and instrumented similar to the ones shown under construction and will be an operational test site in the development program.



Figure 5. Cambridge Development Group's townhouse development in Columbia, South Carolina.

Figures 6, 7, and 8 show solar system installations already in operation. Figure 6 is a photo of the Radian Corporation's office building in Austin, Texas, one of the commercial demonstration projects. The solar system provides heating and cooling for three office areas in the building. The corporation is a research and development firm, and they will correlate and analyse performance data with a similar conventional gas-fired system. Another project in the commercial demonstration program (Fig. 7), the Blakedale Professional Building in Greenwood, South Carolina, is an office building using solar energy for space heating and hot water. Moving to the West Coast, Iris Images uses roof-mounted solar collectors to heat water for film processing purposes (Fig. 8).



Figure 6. Radian Corporation's office building in Austin, Texas.

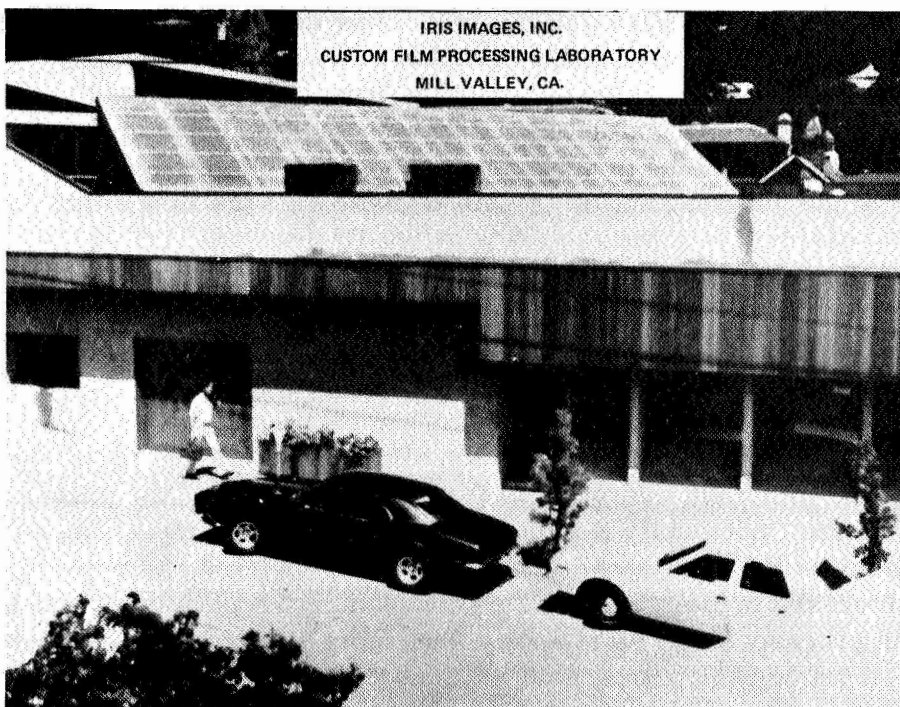


Figure 7. Blakedale Professional Building in Greenwood, South Carolina.





Figure 8. Iris Images, Inc., Custom Film Processing Laboratory, in Mill Valley, California.

One of the very important reasons for having these and other installations in the field (and other government agencies will also have test units out, such as DOD, GSA, and HUD) is to gather performance data, to analyze and assimilate the resulting material, and disseminate useful information derived from these analyses to the using industries (architects, builders, distribution, etc.) and to the general public. Figure 9 illustrates the flow of the data.

As to the program status, MSFC's development program has 30 small and large companies developing systems and subsystems. Hardware is being delivered, tested, and integrated. Its test facilities are practically all operational, and operational test sites are being selected.

In the commercial demonstration effort, 32 sites are in various stages of completion with eight operating in the first increment of the program, the ERDA Program Opportunity Notice (PON) cycle 1 contracts. Evaluation of proposals under the PON cycle 2 has just been completed, 80 more sites were selected from the proposals by ERDA, and contract negotiations with the successful proposers will start soon. Two more PON cycles are planned.



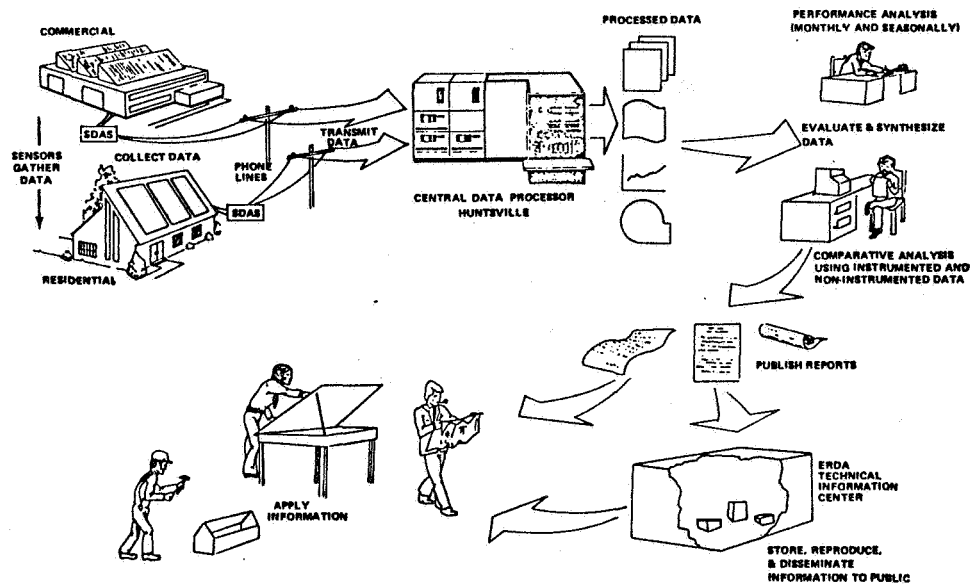


Figure 9. Sensor to User Data System.

In data collection and evaluation, the Development of the data acquisition system is complete, and the total system is operational.

From the standpoint of productivity, solar heating and cooling is certainly a challenge to industry to produce, manufacture, and distribute systems to the public — to begin to reduce our dependence on fossil fuels as one alternative to our national energy problem. MSFC is grateful to have the opportunity to contribute to meeting this challenge.